Data Compression for Multimedia Computing

Mohd Tarmizi Bin Musa

A dissertation submitted in partial fulfilment of the
requirements for the Degree of Master of Science
in the University of East Anglia

School of Information Systems
University of East Anglia
1995

Acknowledgements

A lot have happened during my one year stay at UEA - some good but others best forgotten. I am a year older now and I hope a year wiser too. I would like to think that I have learnt a lot but the fact remains that the more one learns the less one seem to know. The important thing is I have made a start - an important start - a start to the enchanting world of computers. The fulfilment of this dreams is not possible without the constant support of the following people.

To my supervisor, Dr. Dan J. Smith - thank you for the strength you have given me through your guidance and encouragement. Thank you for the things you have done and tried to do for me.

This piece of work is dedicated to a number of people. Firstly, to my late father, whose love I shall never forget. *Ayah,* this is for you - I will miss you but I shall never forget you. My prayers are for you as your prayers have been for me.

To my lovely wife, Habibah this is the price you pay for marrying a man who is thirsty for knowledge. You encourage me when I am dispirited, you hold me when I am demoralise, you give me strength to go on when I am down. Thanks for the patience but please bear with me and I promise you together we will learn to live a fuller, purposeful and more meaningful life.

To my princess, Ili Adibah - your are the source of my inspiration. You will never know, as I will never be able to describe, how much you mean to me. My love for you has no boundary.

To my close friends, here in Norwich and those in Malaysia, thank you for the assistance, understanding and advice. I owe you but I probable will never be able to repay you kindness.

To those I have not mentioned but who have contributed in one way or another please forgive me but thank you all the same.

Finally, to the Almighty - thank you for listening to my prayers.

Abstract

This is a library based study on data compression for multimedia computing. Multimedia information needs a large storage capacity as they contain vast amount of data. This would mean multimedia information would be out of reach of most computer users as their PCs would not be able to store the enormous amount of data accumulated on such programs. However, it is not necessary to keep these data in its original form as there are techniques that could compressed multimedia data to a more manageable level. Therefore, the main objective of this study is to provide information on the availability of compression techniques that would enable PC users the opportunity to use such programs.

The review of related literature reveals that there are two basic compression techniques available - lossless and lossy. Under the lossless technique, the Huffman Coding, Arithmetic Coding and Lempel-Ziv Welch Coding are discussed. On the other hand, the Predictive, Frequency Oriented and Importance Oriented techniques are discussed under the lossy technique. Besides these two main techniques, Hybrid techniques such as the JPEG, MPEG and Px64 are also discussed. In order to bind the discussion between compression and storage media, a description of popular storage media such as magnetic disk storage and optical disc storage are also included.

Although the data are of secondary source, the writer uses a formula derived from Howard and Vitter (1992) to measure compression efficiency. Based on the data collection and analysis it is found that different types of data (text, audio, video etc.) should be compressed using different techniques in order to obtain the ideal compression ratio and quality.

Although the writer believes that the secondary data obtained is sufficient to show the best compression techniques for the different types of multimedia data, he also believes that real experiment using real data, software application and hardware would give better and more precise results.

Contents

Chapter 1

Introduction

1.1 General

The speed of the advancement of computer technology is tremendous. The computer is now being asked to perform tasks that need large storage capacity. The advent of multimedia systems presents a new dimension in terms of data size that needed to be stored. Multimedia is human-computer interaction involving text, graphics, animation, voice and audio. These images, audio and video produce a vast amount of data. Therefore a large storage media is needed to store these data. However, today it is not necessary to have large storage media as compression techniques are playing a more significant role in multimedia computing. Compression techniques are being accepted as a mean to maximize the use of scarce resources to obtain optimum consummation, such as transmission bandwidth and storage capacity. Therefore, there is a need to reduce the redundancy in the data representation, i.e. the techniques to compress the data since many data processing applications involve storage of large volume of data.

The contents of the thesis is for internal user only

References

Bailey, R.L. and Mukkamala, R., Pipelining Data Compression Algorithms. *The Computer Journal,* 1990, Vol. 33, No. 4, pp 308-313.

Bookstein, A. and Storer, J.A. Data Compression. *Information Processing & Management,* 1992, Vol. 28, No. 6, pp. 675-680.

Bookstein, A., and Klein, S.T. Compression, Information Theory, and Grammars: A unified Approach. *ACM Transactions on Information Systems,* January 1990, Vol. *8,* No. 1, pp. 27-49.

Clarke, R.J., Transform Coding of Images. Academic Press Limited, London, 1990.

Davies, D.H., The CD-ROM Medium. *Journal of the Amrican Society for Information Science.* 1988, Vol. 39, No. 1, pp. 34-42.

Fox, E.A. Advances in Interactive Digital Multimedia Systems. *Computer,* October 1991, pp. 9-19.

Fox, E.A. The Coming Revolution In Interactive Digital Video. *Communications of the ACM,* July 1989, Vol. 32, No.7, pp. 795-799.

Furht, B. Multimedia Systems: *An* Overview. *IEEE Multimedia,* Spring 1994, pp. 47-59.

Gall, D.L. MPEG: A Video Compression Standard For Multimedia Applications, *Communications of the ACM,* April 1991, Vol. 34, No.4, pp. 47-58.

Howard, P.G. and Vitter, J.S. Analysis of Arithmetic Coding for data compression. . *Information Processing & Management,* 1992, Vol. 28, No. 6, pp. 749-763.

Howard, P.G. and Vitter, J.S. New Methods For Lossless Image Compression Using Arithmetic Coding. *Znformation Processing & Management,* 1992, Vol. 28, No. 6, pp. 765-779.

JPEG. IS0 IEC JTC 1 Information Technology - Digital Compression and Coding of Continuous-Tone Still Images, Part 1, Requirements and Guidelines. International Standard ISO/IEC IS 10918, 1993.

Korst, J., and Pronk, V. Compact Disc Standards: An Introductory Overview. *Multimedia System,* Oct. 1994, Vol. 2, No. 4, pp. 157-171.

Lelewer, D.A., Hirschberg, D.S., Data Compression. *ACM Computing Surveys,* 1987, Vol.19, pp. 261-296.

MPEG. ISO/IEC Information Technology - Coding of Moving Pictures and Associated Audio for Digital Storage Media at up to about 1.5 Mbit/s, Part 1, Systems, ISO/IEC 11172-1, 1993.

Oscal T.C. Chen, Sheu, B.J., Fang, W.C. Image compression on a VLSI neural-based vector quantizer. ***Information Processing & Management,*** 1992, Vol. 28, No. 6, pp. 687-706.

Pan, D. A Tutorial on MPEG/Audio Compression. ***IEEE Multimedia,*** Summer 1995, pp. 60-74.

PC Direct, September 1995.

Pennebaker, W.B., and Mitchell, J.L., JPEG still image data compression standard. Van Nostrand Reinhold, New York, 1993.

Perchura, M., File Archival Techniques Using Data Compression. ***Communications of the ACM.*** Vol. 25, No, 9, Sept. 1982, pp. 8-19.

Ripley, G.D. DVI - A Digital Multimedia Technology. ***Communications of the ACM,*** July 1989, Vol. 32, No.7, pp. 8 1 l-822.

Rubin, F. Experiments in Text File Compression. ***Communications of the ACM,*** November 1976, Vol. 19, No. 11, pp. 617-623.

Schwerin, J.B., CD-ROM: Potential Markets for Information. ***Journal of the American Society for Information Science.*** 1988, Vol. 39, No. 1, pp. 44-57.

Stair, R.M., Principles of Information System. A Managerial Approach. 1992.

Steinmetz, R. Data compression in multimedia computing - standards and systems. ***Multimedia Systems,*** March 1994, Vol. 1, No. 5, pp. 187-204.

Storer, J. A, Data Compression: Methods and Theory. Computer Science Press, Maryland, USA 1988.

Storer, J. A., Image and Text Compression. Kluwer Academic Publishers, Massachusetts, USA . 1992.

Wallace, S. Managing Mass Storage. ***Byte,*** March 1994, pp. 78-86.

Welch, T.A. A Technique for High-Performance Data Compression. ***Computer.*** June 1984, Vol. 17. No. 6, pp. 8-19.

Williams, R.N., Adaptive Data Compression. Kluwer Academic Publishers. Boston/Dordrecht/London, 199 1.

Witten, I.H., Neal, R.M., Cleary, J.G. Arithmetic Coding for data compression. ***Communication of the ACM.*** June 1987, Vol. 30, No. 6, pp. 520-540.